

Applicant: Boyce et al.
For: A Reinforced Joint for Composite Structures and
Method of Joining Composite Parts

1 1. A method of joining composite parts comprising:
2 disposing a plurality of ^{extrinsic} reinforcing elements ^{each extending} through the thickness of two
3 composite adherends to be joined, at least a number of said reinforcing elements
4 extending from the joint surface of each said (adherend);
5 assembling said adherends so that the joint surface of one said adherend
6 faces the joint surface of the other said adherend defining a joint region therebetween,
7 said extending reinforcing elements interstitially disposed in said joint region; and
8 disposing an adherent within said joint region about said interstitially
9 disposed reinforcing elements and said joint surfaces.

1 2. The method of claim 1 in which said adherends are carbon-carbon
2 composite structures.

1 3. The method of claim 1 in which said reinforcing elements are fibers.

1 4. The method of claim 1 in which said adherent is a metallic braze material.

1 5. A joined composite part structure comprising:
2 a pair of composite adherends each including a plurality of reinforcing
3 elements disposed through the thickness thereof, at least a number of said reinforcing
4 elements extending from the joint surface of each said adherend;
5 a joint region between said adherends bounded by the joint surface of each
6 said adherend and including said extending reinforcing elements interstitially disposed
7 therein; and
8 an adherent about said extending interstitially disposed reinforcing
9 elements between said joint surfaces within the joint region.

1. 6. A method of joining composite parts comprising:
c 2 disposing a plurality of ^{extrinsic} reinforcing elements ^{each extending} through the thickness of two
3 composite adherends, said reinforcing elements extending from the joint surface of each
4 said adherend;
5 assembling said adherends so that the joint surface of one said adherend
6 faces the joint surface of the other said adherend;
7 disposing an adherent interlayer between said opposing joint surfaces;
8 urging said extending reinforcing elements of each said adherend through
9 said adherent interlayer and interstitially locking said reinforcing elements therein.

1 7. The method of claim 6 in which said adherent interlayer is a prepreg
2 material, the method further including the step of curing said material. *Splices?*

1 8. A joined composite part structure comprising:
2 a pair of composite adherends, one said adherend including a plurality of
3 reinforcing elements disposed through the thickness and extending from the joint surface
4 thereof;
5 a joint region between said adherends bounded by the joint surface of each
6 said adherend and including the extending reinforcing elements of said one adherend
7 disposed against the joint surface of the other said adherend; and
8 an adherent disposed in said joint region about said extending reinforcing
9 elements and between said joint surfaces.

9. A method of joining composite parts comprising:

c 2 disposing a plurality of ^{*extrinsic*} reinforcing elements ^{*each extending*} through the thickness of a

3 first composite adherend to be joined, at least a number of said reinforcing elements
4 extending from the joint surface of said first adherend;

5 assembling said first adherend with a second adherend such that the joint
6 surface of the first said adherend faces the joint surface of the second said adherend at
7 the joint region therebetween, said extending elements of said first adherend disposed
8 against the joint surface of said second adherend; and

9 disposing an adherent within said joint region.

10. A method of joining composite parts comprising:

c 2 disposing a plurality of ^{extrinsic} reinforcing elements ^{each extending} through the thickness of a
3 first composite adherend at the joint surface of said first adherend, at least a number of
4 said reinforcing elements extending from the joint surface of said first adherend;
5 assembling said first adherend with a second adherend such that the joint
6 surface of the first said adherend faces the joint surface of the second said adherend;
7 disposing an adherent interlayer between said opposing joint surfaces; and
8 urging said extending reinforcing elements of said first adherend through
9 said adherent interlayer and against the joint surface of the second said adherend and
10 locking said reinforcing elements therein.

1 11. The method of claim 10 in which said adherent interlayer is a prepreg
2 material, the method further including the step of curing said prepreg.

12. A method of joining composite parts comprising:

c 2 disposing a plurality of ^{extrinsic} reinforcing elements ^{each extending} through the thickness of two

3 composite adherends at the joint surface of each said adherend to be joined;

4 assembling said adherends so that the joint surfaces of one said adherend
5 faces the joint surface of the opposing said adherend;

6 disposing an adherent within the joint region defined by said facing joint
7 surfaces and urging said adherent to flow at least partially along the length of said
8 reinforcing elements within said adherends.

13. A method of joining a composite part with a non-composite part
comprising:
inserting, through the thickness of said composite part, a plurality of
reinforcing elements extending from the joint surface thereof;
assembling said composite part such that said reinforcing elements are
proximate the joint surface of said non-composite part; and
brazing said joint surfaces and said reinforcing elements to form a joint.

14. A method of joining composite parts comprising:

inserting, through the thickness of each said composite part, a plurality
c *extrinsic*
of reinforcing elements extending from the joint surface thereof;
assembling said composite parts such that said reinforcing elements are
interstitially disposed at the joint region therebetween;

selecting a braze material compatible with said composite parts and said
reinforcing elements;

applying said braze material to said joint region; and

urging said braze material to flow about said interstitially disposed
reinforcing elements; and

allowing said braze material to harden.

c

15. A method of joining composite parts comprising:
- inserting, through the thickness of one said composite part, a plurality of
- extrinsic*
reinforcing elements extending from the joint surface thereof;
- assembling one said composite part with a second composite part such that
- said reinforcing elements are disposed about the joint surface of said second composite
- part;
- selecting a braze material compatible with said composite parts, and said
- reinforcing elements;
- applying said braze material to the joint region between said composite
- parts;
- urging said braze material to flow about said reinforcing elements; and
- allowing said braze material to harden.

1 16. A method of joining composite parts comprising:
2 inserting, through the thickness of each said composite part, a plurality
3 of reinforcing elements extending from the joint surface thereof;
4 selecting an adherent interlayer material for joining said parts;
5 assembling said composite parts such that said joint surfaces face each
6 other with said adherent interlayer therebetween;
7 driving said reinforcing elements into said adherent interlayer and curing
8 said adherent interlayer locking said reinforcing elements therein.

1 17. A method of claim 16 in which said adherent interlayer is a prepreg
2 material and the step of driving said reinforcing elements and curing includes subjecting
3 the assembly to elevated pressure and temperature.

1 18. A method of joining composite parts comprising:

2 inserting, through the thickness of one composite part, a plurality of

c 3 ^{extrinsic}
reinforcing elements extending from the joint surface thereof;

4 selecting an adherent interlayer material for joining said parts;

5 assembling said composite parts such that said joint surfaces face each
6 other with said adherent interlayer therebetween;

7 driving said reinforcing elements into said adherent interlayer and curing
8 said adherent interlayer locking said reinforcing elements therein.

19. A method of joining a composite part with a non-composite part
comprising:
inserting, through the thickness of said composite part, a plurality of
reinforcing elements at least at the joint region thereof;
assembling said composite part such that said reinforcing elements are
disposed proximate the joint surface of said non-composite part; and
brazing said joint surfaces and urging braze material to flow along the
lengths of said reinforcing elements into said composite part.

1 20. A method of joining composite parts comprising:

2 disposing a plurality of ^{extrinsic} reinforcing elements through the thickness of the

3 composite adherends to be joined, at least a number of said reinforcing elements exposed
4 at the joint surface of each said adherent;

5 assembling said adherends so that the joint surface of one said adherend
6 faces the joint surface of the other said adherend defining a joint region therebetween;
7 and

8 disposing an adherent within said joint region and about said exposed
9 reinforcing elements and said joint surface.

1 21. A joined composite part structure comprising:
2 a pair of composite adherends each including a plurality of reinforcing
3 elements disposed through the thickness thereof, at least a number of said reinforcing
4 elements exposed at the joint surface of each said adherend;
5 a joint region between said adherends bounded by the joint surface of each
6 said adherend and including said exposed reinforcing elements; and
7 an adherent about said exposed reinforcing elements between said joint
8 surfaces within the joint region.

22. A method of joining a composite part with a non-composite part,
comprising:

inserting, through the thickness of said composite part, a plurality of
extrinsic
reinforcing elements at least at the joint region thereof, said reinforcing elements exposed
at the joint surface of said composite part;

assembling said composite part such that said exposed reinforcing
elements are disposed proximate the joint surface of said non-composite part; and

disposing an adherent about said exposed reinforcing elements and said
joint surfaces.

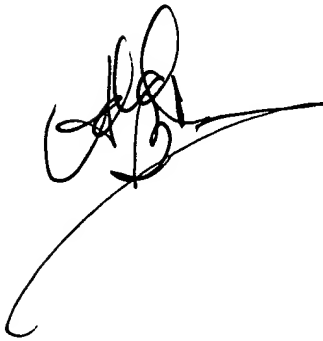
23. A joined structure comprising:

a first adherend having a plurality of reinforcing elements disposed through the thickness thereof exposed at least at the joint surface thereof;

a second adherend the joint surface of which is proximate said exposed reinforcing elements of the first adherent;

a joint region between said adherends bounded by the joint surface of each adherend including said exposed reinforcing elements of said first adherend; and

an adherent disposed in said joint region about said exposed reinforcing elements and between said joint surfaces.

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